# CLAIMS

What Is Claimed Is:

1. A method for establishing a space-time signal constellation, comprising:
   assuming an imperfect knowledge of fading channel state information; and
   using statistics of channel fading to encode additional information into the space-time signal constellation as variations in amplitude of constellation points.

2. The method as claimed in Claim 1, wherein a design criterion for constructing the constellation is the Kullback-Leibler distance between conditional distributions.

3. The method as claimed in Claim 1, further comprising:
   establishing a plurality of the space-time constellations based on a plurality of signal to noise ratio ranges.

4. The method as claimed in Claim 1 further comprising:
   storing information descriptive of the signal constellation in a look-up table.

5. The method as claimed in Claim 1, further comprising:
   storing information descriptive of the signal constellation in a lookup table at a transmitter location.

6. The method as claimed in Claim 1, further comprising:
   storing information descriptive of the signal constellation in a lookup table at a receiver location.

7. The method as claimed in Claim 1, further comprising:
   varying an amplitude of a transmit signal according to constellation data.

8. The method as claimed in Claim 1, further comprising:
   generating the space-time signal constellation for a single transmit antenna system.

9. The method as claimed in Claim 1, further comprising:

identifying one or more signal constellation points that have a particular minimum Kullback-Leibler distance; and

generating the signal constellation as a function of the identifying step.

10. The method as claimed in Claim 1, further comprising:
establishing additional points in the space-time matrix signal constellation having a particular peak magnitude.

11. A symbol detection method comprising:
obtaining a data sample as a function of a received signal;
obtaining channel fading information; and
determining a signal constellation from the data sample and the channel fading information.

12. The method as claimed in Claim 11, wherein the signal constellation includes signal constellation points and a distance between the signal constellation points is a function of a Kullback-Leibler distance between signal constellation points.

13. A computer program, stored on a computer-readable medium, for establishing a space-time signal constellation comprising:

program code, responsive to an assumption of imperfect knowledge of fading channel state information, for using statistics of channel fading to encode additional information into a space-time signal constellation as variations in amplitude of constellation points.

14. The computer program as claimed in Claim 13, further comprising:

program code for determining a distance between the constellation points as a function of a Kullback-Leibler distance between conditional distributions.

15. An electronic storage medium that stores a space-time signal constellation generated by:

assuming an imperfect knowledge of fading channel state information; and

using statistics of channel fading to encode additional information into the space-time matrix signal constellation as variations in amplitude of constellation points.

16. The electronic storage medium as claimed in Claim 15, where the stored signal constellation is further generated by:

determining a distance between the constellation points as a function of a Kullback-Leibler distance between conditional distributions.

17. A wireless communications system network element comprising storage means for storing a digital representation of at least one signal constellation constructed by assuming an imperfect knowledge of fading channel state information and by using statistics of channel fading to encode additional information into the signal constellation as variations in amplitude of constellation points, where a distance between the constellation points is determined a function of a Kullback-Leibler distance between conditional distributions.

18. The network element as claimed in Claim 17, where the network element comprises a part of a base station.

19. The network element as claimed in Claim 17, where the network element comprises a part of a mobile station.

20. The network element as claimed in Claim 17, where the network element comprises part of a receiver symbol detector.

21. The network element as claimed in Claim 17, where the network element comprises part of a transmitter symbol modulator.

22. An apparatus for establishing a space-time matrix signal constellation, comprising: means for assuming an imperfect knowledge of fading channel state information; and means for using statistics of channel fading to encode additional information into the space-time matrix signal constellation as variations in amplitude of constellation points.

23. The apparatus as claimed in Claim 22, further comprising:
means for determining a distance between the constellation points as a function of a Kullback-Leibler distance between conditional distributions.

24. A communication system apparatus for transmitting data using a space-time matrix signal constellation designed based on a Kullback-Leibler distance criterion and by taking into account inaccuracies in a receiver channel estimator.

25. A communication system apparatus for receiving data transmitted by the transmitter of Claim 24, said receiver using coherent demodulation.

26. A communication system apparatus for receiving data transmitted by the transmitter of Claim 24, said receiver apparatus using an optimal demodulator according to a likelihood function given by:

$$p(X \mid S,\hat{H}) = \mathrm{E}_{\tilde{H}}\{p(X \mid S,\hat{H},\tilde{H})\} = \frac{\exp\{-tr[(I_T + \sigma_E^2 SS^H)^{-1}(X - S\hat{H})(X - S\hat{H})^H]\}}{\pi^{TN} \det^N (I_T + \sigma_E^2 SS^H)},$$

where the communication system has $M$ transmit and $N$ receive antennas in a Rayleigh flat fading channel with a coherence interval of $T$ symbol periods, where:

$X = SH + W$,

where $S$ is the $T$ x $M$ matrix of transmitted signals with power constraint $\sum_{t=1}^{T}\sum_{m=1}^{M}\mathrm{E}\{|s_{tm}|^2\} = TP$, where the $s_{tm}$'s are the elements of the signal matrix $S$, $X$ is the $T$ x $N$ matrix of received signals, $H$ is the $M$ x $N$ matrix of fading coefficients, and $W$ is the $T$ x $N$ matrix of the additive received noise, where elements of $H$ and $W$ are assumed to be statistically independent, identically distributed circular complex Gaussian random variables from the distribution CN(0,1), and where it is assumed that $H = \hat{H} + \tilde{H}$, where $\hat{H}$ is known to the receiver but $\tilde{H}$ is not.